



**[4910-13]**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 23**

**[Docket No. FAA-2016-9224; Special Conditions No. 23-277-SC]**

**Special Conditions: Beechcraft, Model A36, Bonanza Airplanes; As Modified by Avionics Design Services, Ltd.; Installation of Rechargeable Lithium Battery**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions; request for comments.

**SUMMARY:** These special conditions are issued for the Beechcraft, Model A36, Bonanza airplane. This airplane, as modified by Avionics Design Services, Ltd., will have a novel or unusual design feature associated with the use of a replacement option of a lithium battery instead of nickel-cadmium and lead-acid rechargeable batteries. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** The effective date of these special conditions is **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

We must receive your comments by **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**

**ADDRESSES:** Send comments identified by docket number FAA-2016-9224 using any of the following methods:

- Federal eRegulations Portal: Go to <http://www.regulations.gov> and follow the online instructions for sending your comments electronically.
- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- Hand Delivery of Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, S.E., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

*Privacy:* The FAA will post all comments it receives, without change, to <http://regulations.gov>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov>.

*Docket:* Background documents or comments received may be read at <http://www.regulations.gov> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200

New Jersey Avenue, SE., Washington, D.C., between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Quentin Coon, Federal Aviation

Administration, Aircraft Certification Service, Small Airplane Directorate, ACE-112, 901

Locust, Room 301, Kansas City, MO; telephone (816) 329-4168; facsimile (816)-329 4090.

**SUPPLEMENTARY INFORMATION:**

The FAA has determined that notice and opportunity for prior public comment hereon are impracticable because these procedures would significantly delay issuance of the approval design and thus delivery of the affected aircraft. In addition, the FAA has determined, in accordance with 5 U.S. C. 553(b)(3)(B) and 553(d)(3), that notice and opportunity for prior public comment hereon are unnecessary because the substance of these special conditions has been subject to the public comment process in several prior instances with no substantive comments received. The FAA therefore finds that good cause exists for making these special conditions effective upon issuance.

Special Conditions Number	Company/Airplane Model
23-15-01-SC <sup>1</sup>	Kestrel Aircraft Company/Model K-350
23-09-02SC <sup>2</sup>	Cessna Aircraft Company/Model 525C (CJ4)
23-08-05-SC <sup>3</sup>	Spectrum Aeronautical, LLC/Model 40

**Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions,

<sup>1</sup>[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgSC.nsf/0/39B156C006EB842E86257EF3004BB13C?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSC.nsf/0/39B156C006EB842E86257EF3004BB13C?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery)

<sup>2</sup>[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgSC.nsf/0/902232309C19F0D4862575CB0045AC0D?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSC.nsf/0/902232309C19F0D4862575CB0045AC0D?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery)

<sup>3</sup>[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgSC.nsf/0/28E630294DCC27B986257513005968A3?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSC.nsf/0/28E630294DCC27B986257513005968A3?OpenDocument&Highlight=installation%20of%20rechargeable%20lithium%20battery)

explain the reason for any recommended change, and include supporting data. We ask that you send us two copies of written comments.

We will consider all comments we receive on or before the closing date for comments. We will consider comments filed late if it is possible to do so without incurring expense or delay. We may change these special conditions based on the comments we receive.

## **Background**

On September 17, 2015, Avionics Design Services, Ltd., (Avionics) applied for a supplemental type certificate (STC) to install a rechargeable lithium battery on the Model A36 Bonanza airplane. The Model A36 airplane is a normal category airplane, powered by a single-piston engine that drives an aircraft propeller, with passenger seating up to six (6) and a maximum takeoff weight of 3600 pounds.

The current regulatory requirements for part 23 airplanes do not contain adequate requirements for the application of rechargeable lithium batteries in airborne applications. This type of battery possesses certain failure and operational characteristics with maintenance requirements that differ significantly from that of the nickel-cadmium (Ni-Cd) and lead-acid rechargeable batteries currently approved in other normal, utility, acrobatic, and commuter category airplanes. Therefore, the FAA is proposing this special condition to address (1) all characteristics of the rechargeable lithium batteries and their installation that could affect safe operation of the modified Model A36 airplane, and (2) appropriate Instructions for Continued Airworthiness (ICAW) that include maintenance requirements to ensure the availability of electrical power from the batteries when needed.

## **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (CFR) 21.101, Avionics must show that the Model A36 airplane, as changed, continues to meet the applicable provisions of the regulations incorporated by reference in Type Certificate Data Sheet No. 3A15<sup>4</sup> or the applicable regulations in effect on the date of application for the change.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 23) do not contain adequate or appropriate safety standards for the Model A36 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

In addition to the applicable airworthiness regulations and special conditions, the Model A36 airplane must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in § 11.19, under § 11.38 and they become part of the type certification basis under § 21.101.

Special conditions are initially applicable to the models for which they are issued. Should the applicant apply for an STC to modify any other model included on the same type certificate to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

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<sup>4</sup> [http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgMakeModel.nsf/0/360C62B668F4C1878625801B0069FB5F?OpenDocument](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/0/360C62B668F4C1878625801B0069FB5F?OpenDocument)

## **Novel or Unusual Design Features**

The Beechcraft Model A36 airplane will incorporate the following novel or unusual design features:

The installation of a rechargeable lithium battery as a main or engine start aircraft battery.

## **Discussion**

The applicable part 23 airworthiness regulations governing the installation of batteries in general aviation airplanes, including § 23.1353, were derived from Civil Air Regulations (CAR) 3 as part of the recodification that established 14 CFR part 23. The battery requirements, which are identified in § 23.1353, were a rewording of the CAR requirements that did not add any substantive technical requirements. An increase in incidents involving battery fires and failures that accompanied the increased use of Ni-Cd batteries in aircraft resulted in rulemaking activities on the battery requirements for small airplanes. These regulations were incorporated into § 23.1353(f) and (g), which apply only to Ni-Cd battery installations.

The introduction of lithium batteries into aircraft raises some concern about associated battery or cell monitoring systems and the impact to the electrical system when monitoring components fail. Associated battery or cell monitoring systems (e.g., temperature, state of charge, etc.) should be evaluated with respect the expected extremes in the aircraft operating environment.

Lithium batteries typically have different electrical impedance characteristics than Ni-Cd or lead-acid batteries. Avionics needs to evaluate other components of the aircraft electrical system with respect to these characteristics.

Presently, there is limited experience with use of rechargeable lithium batteries and rechargeable lithium battery systems in applications involving commercial aviation. However, other users of this technology, ranging from personal computers, wireless telephone manufacturers to the electric vehicle industry, have noted safety problems with rechargeable lithium batteries. These problems include overcharging, over-discharging, flammability of cell components, cell internal defects, and during exposure to extreme temperatures that are described in the following paragraphs.

1. Overcharging: In general, rechargeable lithium batteries are significantly more susceptible than their Ni-Cd or lead-acid counterparts to thermal runaway, which is an internal failure that can result in self-sustaining increases in temperature and pressure. This is especially true for overcharging which causes heating and destabilization of the components of the cell, leading to the formation (by plating) of highly unstable metallic lithium. The metallic lithium can ignite, resulting in a self-sustaining fire or explosion. Finally, the severity of thermal runaway due to overcharging increases with increasing battery capacity due to the higher amount of electrolyte in large batteries.

2. Over-discharging: Discharge of some types of rechargeable lithium battery cells beyond the manufacturer's recommended specification can cause corrosion of the electrodes of the cell, resulting in loss of battery capacity that cannot be reversed by recharging. This loss of capacity may not be detected by the simple voltage measurements commonly available to flight crews as a means of checking battery status—a problem shared with Ni-Cd batteries. In addition, over-discharging has the potential to lead to an unsafe condition (creation of dendrites that could result in internal short circuit during the recharging cycle).

3. Flammability of Cell Components: Unlike Ni-Cd and lead-acid batteries, some types of rechargeable lithium batteries use liquid electrolytes that are flammable. The electrolyte can serve as a source of fuel for an external fire, if there is a breach of the battery container.

4. Cell Internal Defects: The rechargeable lithium batteries and rechargeable battery systems have a history of undetected cell internal defects. These defects may or may not be detected during normal operational evaluation, test and validation. This may lead to an unsafe condition during in service operation.

5. Extreme Temperatures: Exposure to an extreme temperature environment has the potential to create major hazards. Care must be taken to ensure that the lithium battery remains within the manufacturer's recommended specification.

These problems experienced by users of lithium batteries raise concern about the use of lithium batteries in aviation. The intent of the proposed special condition is to establish appropriate airworthiness standards for lithium battery installations in the Model A36 airplanes and to ensure, as required by §§ 23.1309 and 23.601, that these battery installations are not hazardous or unreliable.

### **Applicability**

The special conditions are applicable to the Model A36 airplane. Should Avionics apply at a later date for an STC to modify any other model included on Type Certificate No. 3A15, to incorporate the same novel or unusual design feature, the special conditions would apply to that model as well.



## **Conclusion**

This action affects only certain novel or unusual design features on the Model A36 airplane. It is not a rule of general applicability and affects only the applicant who applied to the FAA for approval of these features on the airplane.

The substance of these special conditions has been subjected to the notice and comment period in several prior instances and has been derived without substantive change from those previously issued. It is unlikely that prior public comment would result in a significant change from the subject contained herein. Therefore, notice and opportunity for prior public comment hereon are unnecessary and the FAA finds good cause, in accordance with 5 U.S. Code §§ 553(b)(3)(B) and 553(d)(3), making these special conditions effective upon issuance. The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment described above.

## **List of Subjects in 14 CFR Part 23**

Aircraft, Aviation safety, Signs and symbols.

## **Citation**

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113 and 44701; 14 CFR 21.16 and 21.101; and 14 CFR 11.38 and 11.19.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the supplemental type certification basis for Beechcraft, Model A36 airplanes modified by Avionics Design Services, Ltd.

### **1. Installation of Lithium Battery**

The FAA adopts that the following special conditions be applied to lithium battery installations on the Model A36 airplanes in lieu of the requirements § 23.1353 (a)(b)(c)(d)(e), amendment 49.

Lithium battery installations on the Model A36 airplanes must be designed and installed as follows:

- a. Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition, or during any failure of the charging or battery monitoring system not shown to be extremely remote. The lithium battery installation must be designed to preclude explosion or fire in the event of those failures.
- b. Lithium batteries must be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.
- c. No explosive or toxic gasses emitted by any lithium battery in normal operation or as the result of any failure of the battery charging or monitoring system, or battery installation not shown to be extremely remote, may accumulate in hazardous quantities within the airplane.
- d. Lithium batteries that contain flammable fluids must comply with the flammable fluid fire protection requirements of 14 CFR 23.863(a) through (d).

e. No corrosive fluids or gases that may escape from any lithium battery may damage airplane structure or essential equipment.

f. Each lithium battery installation must have provisions to prevent any hazardous effect on structure or essential systems that may be caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

g. Lithium battery installations must have—

(1) A system to control the charging rate of the battery automatically to prevent battery overheating or overcharging, or

(2) A battery temperature sensing and over-temperature warning system with a means for automatically disconnecting the battery from its charging source in the event of an over-temperature condition or,

(3) A battery failure sensing and warning system with a means for automatically disconnecting the battery from its charging source in the event of battery failure.

h. Any lithium battery installation functionally required for safe operation of the airplane, must incorporate a monitoring and warning feature that will provide an indication to the appropriate flight crewmembers, whenever the capacity and state of charge of the batteries have fallen below levels considered acceptable for dispatch of the airplane.

i. The ICAW must contain recommended manufacturer's maintenance and inspection requirements to ensure that batteries, including single cells, meet a functionally safe level essential to the aircraft's continued airworthiness.

(1) The ICAW must contain operating instructions and equipment limitations in an installation maintenance manual.

(2) The ICAW must contain installation procedures and limitations in a maintenance manual, sufficient to ensure that cells or batteries, when installed according to the installation procedures, still meet safety functional levels essential to the aircraft's continued airworthiness. The limitations must identify any unique aspects of the installation.

(3) The ICAW must contain corrective maintenance procedures to check battery capacity at manufacturer's recommended inspection intervals.

(4) The ICAW must contain scheduled servicing information to replace batteries at manufacturer's recommended replacement time.

(5) The ICAW must contain maintenance and inspection requirements how to check visually for battery and charger degradation.

j. Batteries in a rotating stock (spares) that have degraded charge retention capability or other damage due to prolonged storage must be checked at manufacturer's recommended inspection intervals.

k. If the lithium battery application contains software and/or complex hardware, in accordance with AC 20-115<sup>5</sup> and AC 20-152<sup>6</sup>, they should be developed to the standards of DO-178 for software and DO-254 for complex hardware.

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<sup>5</sup>[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgAdvisoryCircular.nsf/0/E35FBC0060E2159186257BBE00719FB3?OpenDocument&Highlight=ac%2020-115b](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/E35FBC0060E2159186257BBE00719FB3?OpenDocument&Highlight=ac%2020-115b)

<sup>6</sup>[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgAdvisoryCircular.nsf/0/6D4AE0BF1BDE3579862570360055D119?OpenDocument&Highlight=ac%2020-152](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/6D4AE0BF1BDE3579862570360055D119?OpenDocument&Highlight=ac%2020-152)

Compliance with the requirements of this Special Condition must be shown by test or analysis, with the concurrence of the New York Aircraft Certification Office.

Issued in Kansas City, Missouri on September 28, 2016.

William Schinstock  
Acting Manager, Small Airplane Directorate  
Aircraft Certification Service

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